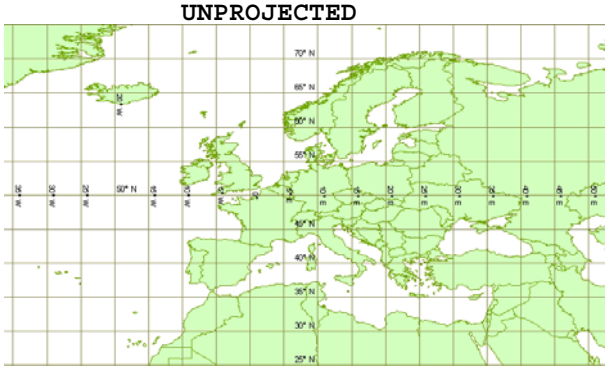
OFFICE OF TARGETING AND TRANSNATIONAL ISSUES (PR)
GEOSPATIAL SCIENCES DIVISION (PRG)
COORDINATE SYSTEMS ANALYSIS TEAM (CSAT)
FEBRUARY 2005

AN NGA GEOSPATIAL ANALYST'S QUICK-START GUIDE TO ArcGIS™ MAP PROJECTIONS

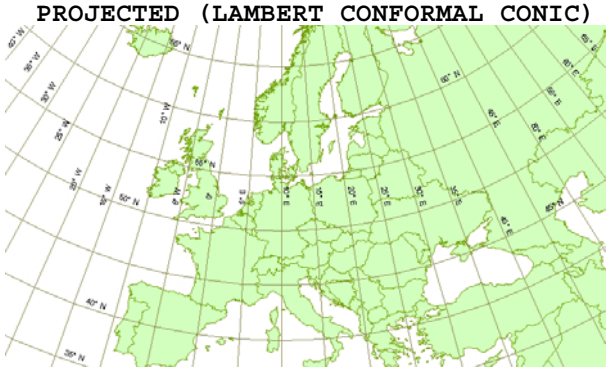
This guide is intended for the generation of custom products such as reference maps, planning maps, graphics that accompany geospatial studies, and digital GIS products. It should NOT be used as guidance for NGA standard products or any other product used in navigation or targeting.

WHEN CREATING MAPS, GIS DATA SHOULD NEVER BE LEFT IN THE DEFAULT "UNPROJECTED" COORDINATE SYSTEM. ALWAYS SELECT AN APPROPRIATE MAP PROJECTION FOR DISPLAYING GEOSPATIAL DATA AND REFERENCE MAPS.

UNPROJECTED



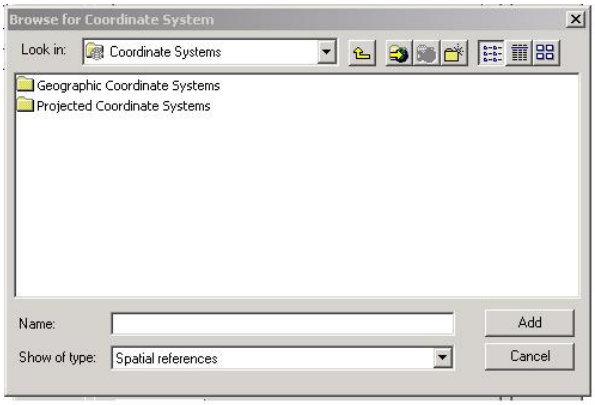
PROJECTED (LAMBERT CONFORMAL CONIC)



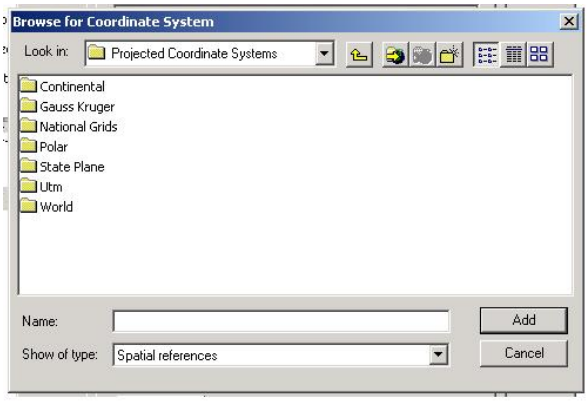
With the exception of maritime and polar charts, NGA maps and charts mainly use the **Lambert Conformal Conic (LCC)** and **Transverse Mercator (TM)** projections. Therefore, as a general rule of thumb, use TM (or UTM) for large-scale (small area) maps, and LCC for small-scale (large-area) maps.

FOLLOWING IS A BRIEF GUIDE TO ArcGIS™ MAP PROJECTIONS.

First, select **"Projected Coordinate Systems". "Geographic Coordinate Systems"** do not contain map projections, but are used to process GIS data that are in a local datum.



Select one of the following **Projected Coordinate System** categories according to your Area of Interest and mapping need:



The remainder of this guide will provide some brief definitions for each of the above categories.

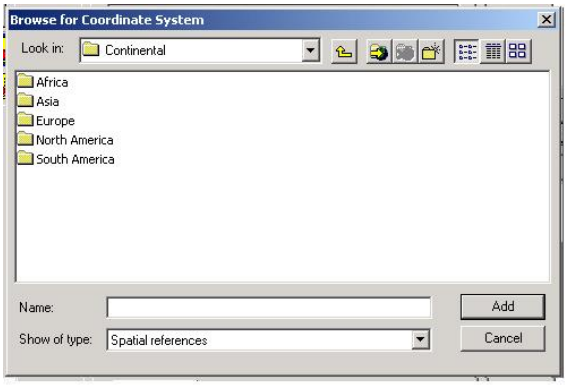
- **"<u>Continental</u>" contains <u>conic</u> projections.**
  - **<u>Lambert Conformal Conic</u>,** or "LCC", is a good conformal projection for areas in mid-latitudes. Distortion is minimized along east-west standard parallels. It's good for displaying large multi-national regions and continents. TPCs and ONCs use LCC.
  - **<u>Albers Equal Area</u>.** Areas on map are proportional to areas on earth.

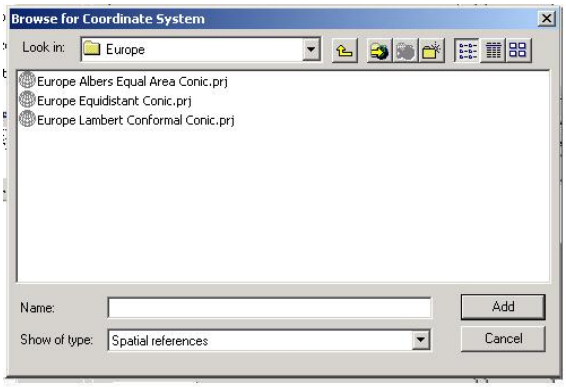
- **Equidistant.** Distances are true along meridians and standard parallels.

To suit your area of interest, you may want to modify the map projection parameters: **Standard Parallels 1 & 2**, and **Central Meridian**.

- Scale and distance are "true" along the standard parallels.
- The Central Meridian is the one meridian on the map where north is "straight up".

"CONTINENTAL" MENU DISPLAYS:





- **"Gauss Kruger",** or "GK", is very similar to UTM. Some countries use GK instead of UTM for their grid system. This would be used when dealing with coordinates of a grid system that uses the GK.

- **"National Grids"** are grid systems for individual countries, each based on a map projection. As with GK, use this when working with coordinates of a particular country's grid system.

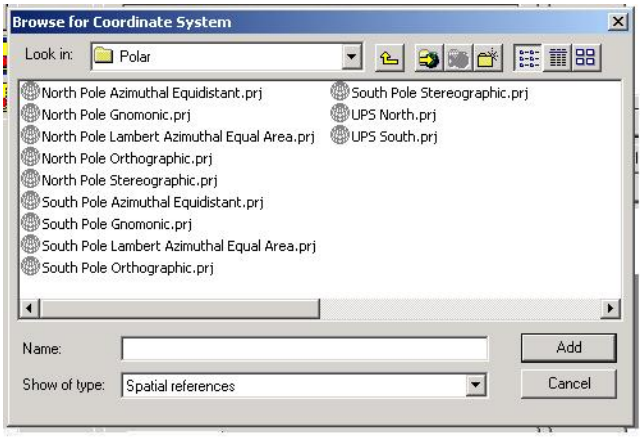
- **"Polar"** contains **planar,** a.k.a. **azimuthal,** projections. These types of projections are needed to map polar areas, BUT, for some purposes, they are **ALSO useful in non-polar areas.**

  For non-polar uses, modify the map projection parameters: **Central Meridian** and **Latitude of Origin**.

  - **Azimuthal Equidistant**. All distances from the origin point of the projection are true.
  - **Gnomonic**. All great circles on the globe are straight lines on the map.

- **Lambert Azimuthal Equal Area**. Areas of polygons are true.
- **Orthographic**. Useful for displaying the world as a globe.
- **Stereographic**. Used in geophysics and other applications.
- **UPS**. Universal Polar Stereographic system, the polar segment of the UTM/MGRS system.

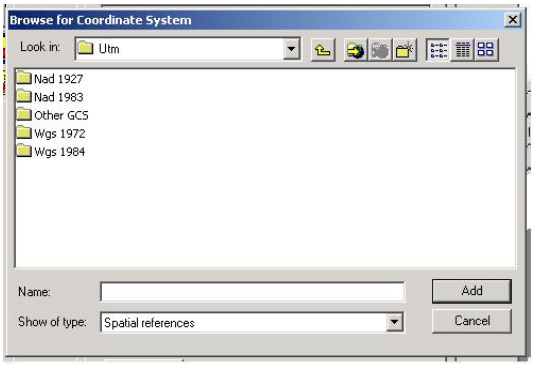
"POLAR" MENU DISPLAY:

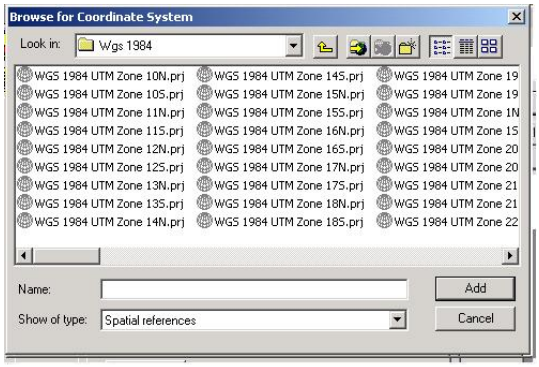


- "**State Plane**" contains individual state grid systems in the U.S. Used by surveyors, engineers, city governments, etc.

- "**UTM**" contains all 60 UTM/MGRS zones, each based on the **Transverse Mercator Projection**.
  - **NOTE: USE "UTM" FOR ANY TRANSVERSE MERCATOR PROJECTION**, whether part of the UTM system or not (if not, parameters will be modified).
  - Transverse Mercator is a good conformal projection for areas that stretch in a north-south direction. Distortion is minimized along the central meridian.

"UTM" MENU DISPLAYS:





- "**World**" contains various projections that are useful for displaying a world map. Some (e.g. Mercator) are also useful for displaying equatorial regions.

REFERENCES:

- *Understanding Map Projections,* by Melita Kennedy and Steve Kopp, ESRI, 2000.
- *Map Projections* (Poster), U.S. Geological Survey. See http://erg.usgs.gov/isb/pubs/MapProjections/projections.html

POC: KURT SCHULZ, PRGB/CSAT, 314-263-4171.

Watch for future editions of this guide, which will include additional topics such as: Datums, saving shapefiles in projections, .PRJ files, grid systems, and more specific information on coordinate system parameters.

FOR QUESTIONS, PROBLEMS, OR ISSUES PERTAINING TO MAP PROJECTIONS, CONTACT A CSAT TEAM MEMBER.

The Coordinate System Analysis Team

St. Louis: 314-263-4171 (DSN - 693-4171)

Scott Spaunhorst (Team Leader)

Brian Akers
Paul Fitzpatrick
Steve Gruendler
Diane Lapinski
Lawrence Nault
Craig Rollins
Kurt Schulz
Elnora ("Cookie") Szlauko
Brodie Thompson

Bethesda: 301-227-3340 (DSN - 287-3340)

Roger Foster
Dennis McCleary
Dan Mullaney